Airborne Multi-Gas Sensor, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

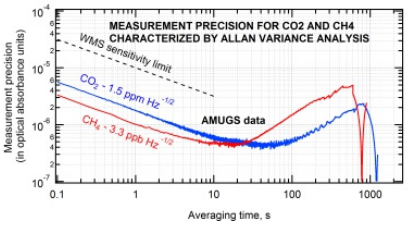
ABSTRACT

Mesa Photonics has developed laser-based gas sensor technology compatible with UAV deployment. Our Airborne MUlti-Gas Sensor (AMUGS) technology is based upon two-tone frequency-modulated spectroscopy (TT-FMS). TT-FMS retains the advantages of near-infrared diode lasers while pushing detection sensitivity more than two orders of magnitude closer to the theoretical limit. Phase I results demonstrated that lightweight, low-power near-infrared systems can deliver sensitivity competitive with mid-infrared gas analyzers. This factor is important for UAV deployment because near-infrared systems that use fiber optic telecommunications components are robust, versatile, and cost-effective. AMUGS uses an open path optical cell that is lighter and more robust than instruments based on cavity-enhanced spectroscopy methods. In, Sensitivity demonstrated in Phase I was a factor of 5-10x better than its nearest competing techniques. Benchtop TT-FMS delivered sensitivities at 10 Hz of 5 ppm for CO2 and 12 ppb for CH4. Precision improved to 1.5 ppm for CO2 and 3.3 ppb for CH4 with 1 sec of signal averaging. The Phase II target is to design and build a flight-ready TT-FMS prototype that maintains or exceeds this benchtop detection precision. The AMUGS prototype will meet 5 kg and 50 W targets and will be flown on an all-electric model aircraft at the University of Texas at Dallas. This airborne testing will provide critical information that will help further development and commercialization of the AMUGS technology.

ANTICIPATED BENEFITS

To NASA funded missions:

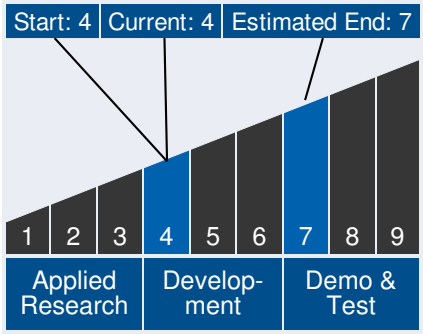
Potential NASA Commercial Applications: AMUGS meets NASA's needs for airborne measurements of carbon dioxide and methane. Work proposed in Phase II will focus on design and engineering to produce a field-testable, UAV-compatible prototype. The AMUGS concept builds upon existing high-performance spectroscopy and has demonstrated the



Airborne Multi-Gas Sensor

Table of Contents

Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

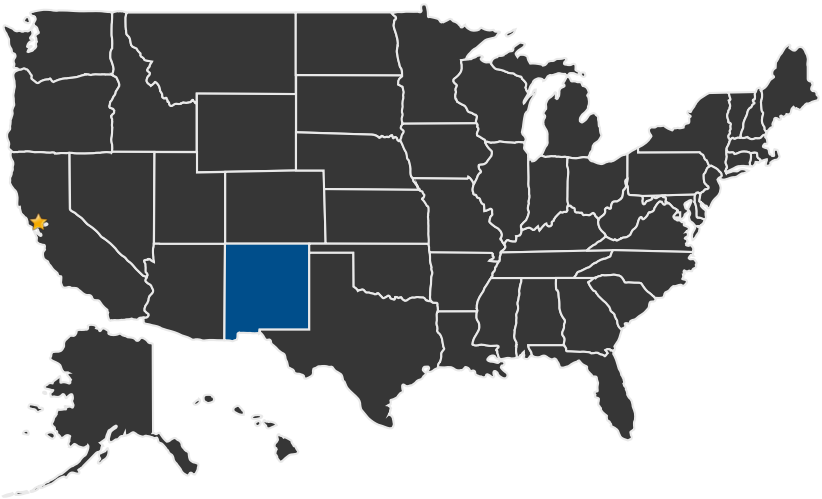
Continued on following page.

simultaneous, real-time detection of multiple gases. The common optical path and detector of the system not only reduce sources of noise and error but also decrease device complexity, mass and footprint. The AMUGS design is based upon robust, mature telecom technologies: fiber- coupled diode lasers and WiFi electronics. AMUGS provides a sensitive gas sensor in a compact, light and low power package that is directly compatible with unattended, remote sensing upon a UAV platform.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Numerous investigators are conducting research on anthropogenic methane and other gases. AMUGS could provide a valuable tool to groups seeking to gather high-resolution spatial and temporal data of gas concentrations aloft. AMUGS size, power and performance characteristics would make airborne gas measurements accessible to a wide variety of non-NASA research groups and agencies.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Ames Research Center

Management Team *(cont.)*

Principal Investigator:
- Marwood Ediger

Technology Areas

Secondary Technology Area:
Science Instruments, Observatories, and Sensor Systems (TA 8)
└ Remote Sensing Instruments and Sensors (TA 8.1)
  └ Lasers (TA 8.1.5)

Other Organizations Performing Work:

- Mesa Photonics, LLC (Santa Fe, NM)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/18075)

DETAILS FOR TECHNOLOGY 1

Technology Title

Airborne Multi-Gas Sensor